Dissertation Title	EEG-Based Detection of Induced Relaxation
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ABSTRACT

Relaxation, defined as the absence of stress, is important for health, as prolonged periods of tension can lead to illness. This study detects induced relaxation through electroencephalography (EEG) for real-time monitoring of brain activities. This study employed the Multivariate Empirical Mode Decomposition with Dynamic Phase-Synchronized Hilbert-Huang Transform (MEMD-DPS-HHT) algorithm to extract dynamic patterns of brain waves. The dataset of essential oil blends was preprocessed to remove artifacts using independent component analysis (ICA), bandpass filtering in the 4-12 Hz frequency range, and normalization. The EEG data were decomposed into five Intrinsic Mode Functions (IMFs) utilizing the MEMD method. The average frequencies of IMF1 during the eyes-closed and eyes-open conditions are 8.56 Hz and 10.77 Hz, respectively. For IMF2, the frequencies are 4.91 Hz and 6.72 Hz, respectively. Phase synchronization analysis across channels revealed a maximum coherence of 0.87. The dynamic Hilbert spectra and relaxation indices, pre- and post-stimulation, averaged a maximum of 0.16. This finding was consistent with the paired t-test and factorial design experiment results, both of which showed no significant differences in theta and alpha bands pre- and post-stimulation. The findings indicate that MEMD-DPS-HHT effectively analyzes cross-channel, multidimensional, and dynamic EEG data related to relaxation.

Keywords: MEMD, Dynamic Phase-Synchronized, Hilbert-Huang Transform, Phase Coherence, Relaxation Index, EEG